Good Practice

Guide 96

ENERGY EFFICIENCY IN NEW HOUSING

Detailing for designers and building professionals

WINDOWS AND EXTERNAL DOORS

"Double glazing is regarded as the minimum standard for energy efficient new dwellings"

Energy Efficiency Office
DEPARTMENT OF THE ENVIRONMENT

Contents

Foreword

This Guide is one of a series produced by BRECSU for the EEO under the title *Energy efficiency in new housing: detailing for designers and building professionals*. The other Guides in this series are:

- Good Practice Guide 93 – *Key detailing principles*
- Good Practice Guide 94 – *Ground floors*
- Good Practice Guide 95 – *External cavity walls*
- Good Practice Guide 97 – *Pitched roofs*

To complement these Good Practice Guides there is a companion series with the title *Energy efficiency in new housing: site practice for tradesmen*. The following are relevant to windows and external doors:

- Good Practice Guide 106 – *Installing frames and insulated glazing units*
- Good Practice Guide 107 – *Installing factory-finished components*
- Good Practice Guide 108 – *Insulating reveals*

All the details in this Guide assume that windows are double glazed. This is regarded as the minimum standard for energy efficient new dwellings. The need to improve the air tightness of the wall/window junction is highlighted.

The structure of the Guide

This Guide is divided into three Sections. Section 96.1 deals with the general points of detailing lintels, jambs and sills and includes sets of exemplar details. Section 96.2 deals with additional detailing points that are specific to built-in windows and doors. Section 96.3 deals with the detailing of windows and doors in prepared openings.

To make comparisons between alternative details easier, each Section is structured in the same way.

- Introduction with 'Features' box
- Construction options
- The main technical risks
- An explanation of each technical risk in turn, with a list of the key detailing points to either avoid, or minimise the risk
- Specification Notes
- Buildability Points.

Acknowledgements

The cooperation of the following organisations in the preparation of this Guide is gratefully acknowledged.
Building Employers Confederation, Energy Group North West (CIBSE, CIOB, RIBA, RICS), National House-Building Council, Chartered Institute of Building, DOE, BRE, Construction Industry Training Board, NBA Tectonics, Wimpey Environmental.

Guide 96.1

ENERGY EFFICIENCY IN NEW HOUSING

Detailing for designers and building professionals

INTRODUCTION

Detailing at lintels, jambs and sills involves a large number of permutations of window position, lintel type, method of wall insulation and design of subsill. Of these, it is mainly the window frame position that determines the suitability of a detail for particular conditions of exposure to driving rain. An explanation of exposure zones is given in EEO Good Practice Guide 95.

This Good Practice Guide lists the detailing points that relate to three alternative positions of the window frame:

- set forward within the outer leaf
- set back 25 to 50 mm behind the outer leaf
- in a rebated reveal.

This Section should be read in conjunction with Section 96.2 if windows are to be built-in during construction, or Section 96.3 if windows are to be fixed into prepared openings.

FEATURES

- Rebated reveals are recommended in Scotland and Northern Ireland and in Severe and Very Severe exposure zones elsewhere in the UK.
- Windows located within the outer leaf should have insulated reveals and soffits to avoid thermal bridging.
- Where lintels have a continuous lower web, the soffit should be insulated to avoid chilling the plaster.
- If the cavity is closed at the sill, the sill dpc should be turned up the back of the sill and be lapped by the vertical dpc.
- Sills should project at least 50 mm from the wall.
- Insulating foam used to fill the joint between the frame and the surrounding masonry not only cuts down air leakage but also provides a thermal break.

WINDOWS AND EXTERNAL DOORS

Detailing lintels, jambs and sills

"Thermal bridging problems around window and door openings can be avoided if the wall insulation is taken up to the back of the frame"

CONSTRUCTION OPTIONS

The main construction options when detailing lintels, jambs and sills are shown in table 1. Some of these options are not suitable for sites with a Moderate/Severe or more severe exposure to driving rain. Where use is limited to particular exposure zones, this is noted in the text.

Details specific to built-in windows are given in Section 96.2, whilst detailing of windows in prepared openings is in Section 96.3.

MAIN TECHNICAL RISKS

The main technical risks at openings are:

- **rain penetration** if the window or door opening is not adequately detailed or protected from wind driven rain
- **thermal bridging** at reveals, where a steel lintel has a continuous lower web or the window frame does not overlap an insulated lintel, cavity closer or sill
- **air infiltration** where there are gaps between the frame and the wall, or around edges of a dry lining.

DETAILING AGAINST RAIN PENETRATION

Window and door openings can be detailed to resist rain penetration by:

- the correct use of dpcs and cavity trays
- ensuring that projections throw water clear of the wall
- sealing the vulnerable frame/wall junction
- using a rebated reveal where the window is subject to Severe or Very Severe exposure.

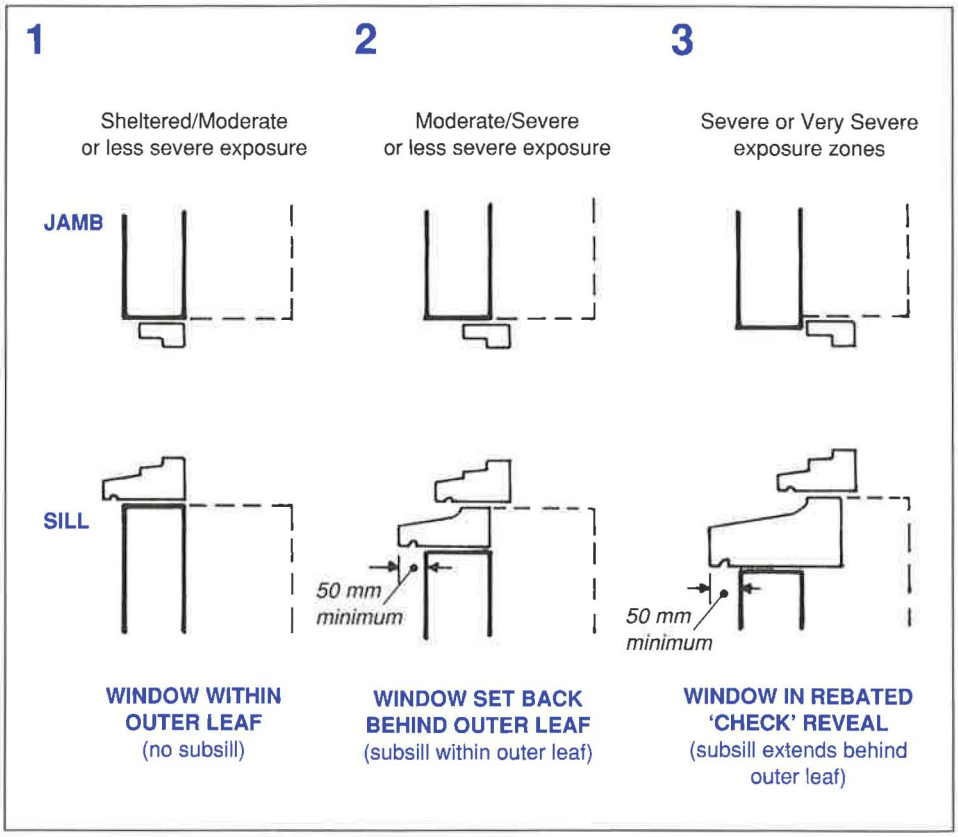
Recommendations on good detailing practice appear in BS 5628 : Part 3 and the BRE Report *Thermal insulation: avoiding risks*.

The **key detailing points** follow.

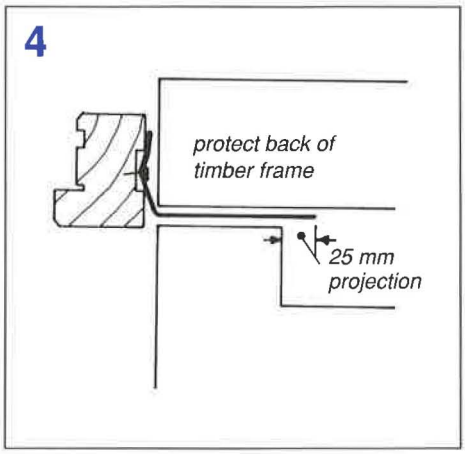
- In Sheltered/Moderate or less severe exposure zones, the window may be set within the outer leaf without the need for a separate subsill (see Diagram 1).
- In Moderate/Severe exposure zones, the window should be set back to overlap the cavity closer and have a separate subsill which projects beyond the outer leaf by not less than 50 mm (see Diagram 2).
- In Severe or Very Severe exposure zones, the window should be located in a rebate behind the outer leaf (a 'check' reveal) (see Diagram 3).
- A dpc should be placed below and turned up behind any subsill which is not formed of unjointed impervious material. In Severe and Very Severe exposure zones all subsills should have a dpc (see Diagram 7).
- The vertical dpc should protect the back of timber frames from contact with damp masonry (see Diagrams 4, 6 and 7).
- At jambs closed by returning the inner leaf of masonry, the vertical dpc should extend 25 mm into the cavity beyond the closer (see Diagram 4).
- The reveal and subsill dpcs should be linked to prevent direct contact between external masonry and the inner leaf (see Diagrams 6 and 7).

Item	Range of construction options
Installation method	built-in / fixed in prepared openings
Window position	set forward / set back / rebated
Wall insulation method	full fill / partial fill / internal lining
Reveal detail	insulated lining / insulated closer / jamb insulation / lightweight blockwork
Lintel type	box type / insulated 'top hat' / aircrete
Subsill type	concrete / brick / tile / metal / plastics / slate / timber
Frame fixing method	cramps (built-in) / through fixing (prepared opening) / lugs or brackets (prepared opening)

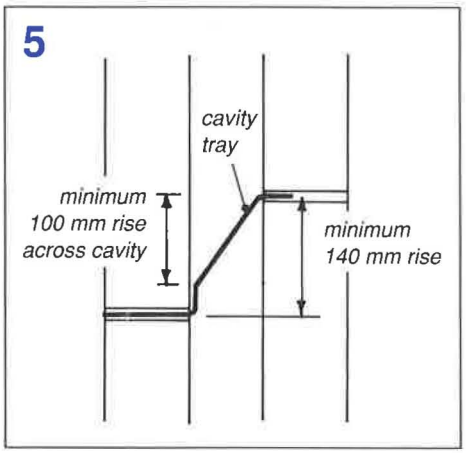
Table 1 Construction options



Locations of windows in relation to the outer leaf at a structural opening

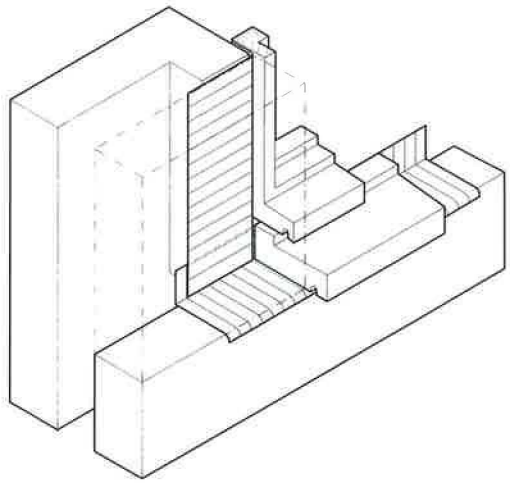


Detailing the vertical dpc



Detailing the cavity tray

6



SUBSILL WITHIN OUTER LEAF

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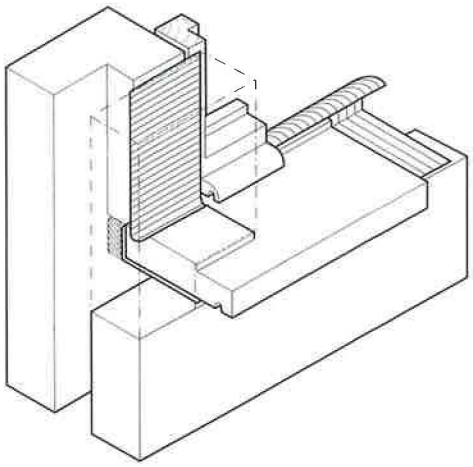


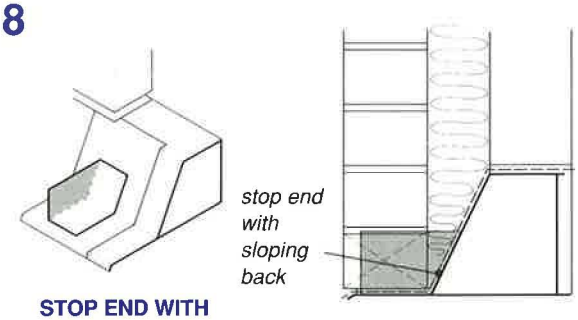
SUBSILL WITH WINDOW IN 'CHECK' REVEAL

Linking of reveal and subsill dpcs

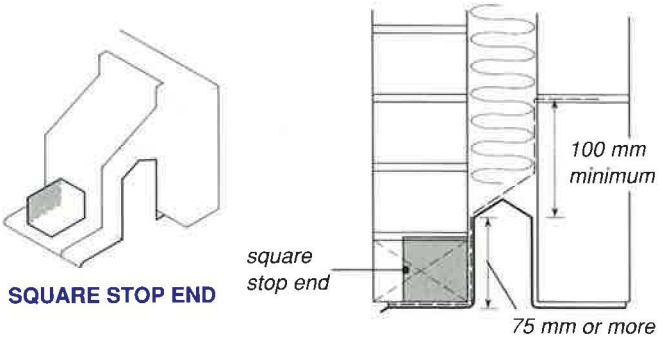
- The sill or subsill should project at least 50 mm from the face of the wall and incorporate a throating to throw water clear. The projection may be less in Very Sheltered exposure zones.
- Cavity trays (or lintels not protected by cavity trays) should rise at least 140 mm between the outer and inner leaves and at least 100 mm across the cavity (see Diagram 5).
- Lintels should always have a separate cavity tray, returned to the inner leaf, in Severe and Very Severe exposure zones and always when a brick soldier course is used above the opening.
- Weepholes to drain cavity trays should be provided at maximum 450 mm centres, with at least two over each opening.
- Stop ends should be provided to lintels or their cavity trays whenever full cavity insulation is used (see Diagram 8).
- Where the window frame meets the lintel and the surrounding masonry, the joint should be pointed with a sealant (see Diagrams 9 and 10).

Concrete subsill with 50 mm projection and throating

8



STOP END WITH SLOPING BACK



SQUARE STOP END

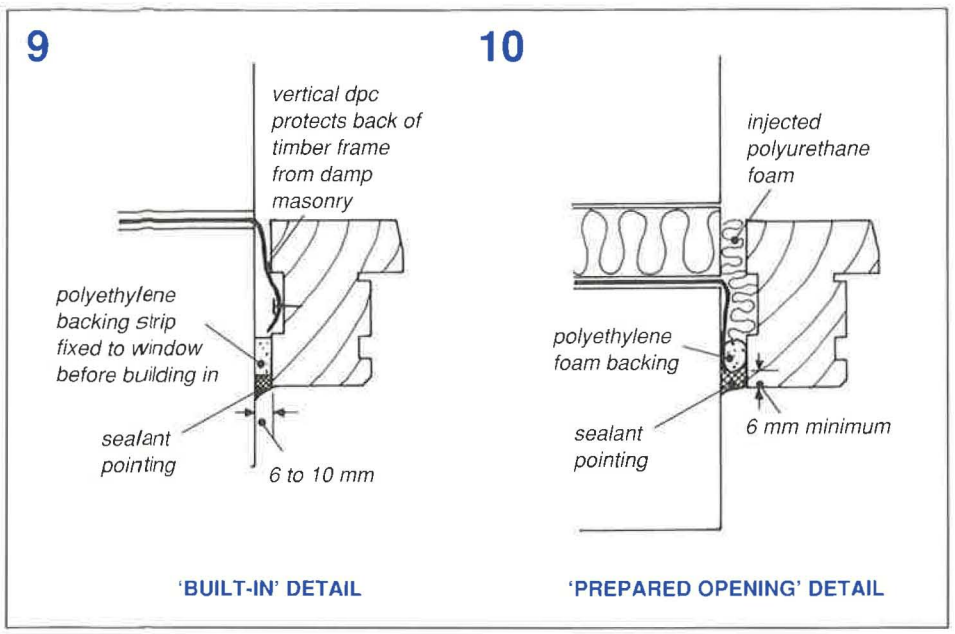
LINTEL WITH A SIMPLE SLOPE WITHIN THE CAVITY

- stop ends with a sloping back should be used
- the angle of slope will vary slightly between lintels of different heights
- a separate cavity tray is sometimes needed

LINTEL WITH VERTICAL FRONT

- simple square stop end should be used
- a separate cavity tray is needed with this lintel profile

Detailing stop ends to lintels



Detailing sealant at the frame/wall junction

DETAILING TO AVOID THERMAL BRIDGING

Thermal bridging problems around window and door openings can be avoided if the wall insulation is taken up to the back of the frame. The frame should overlap the insulation by at least 25 mm to minimise the risk of mould growth and surface condensation. The details in this Guide show a variety of ways this can be achieved.

The **key detailing points** follow.

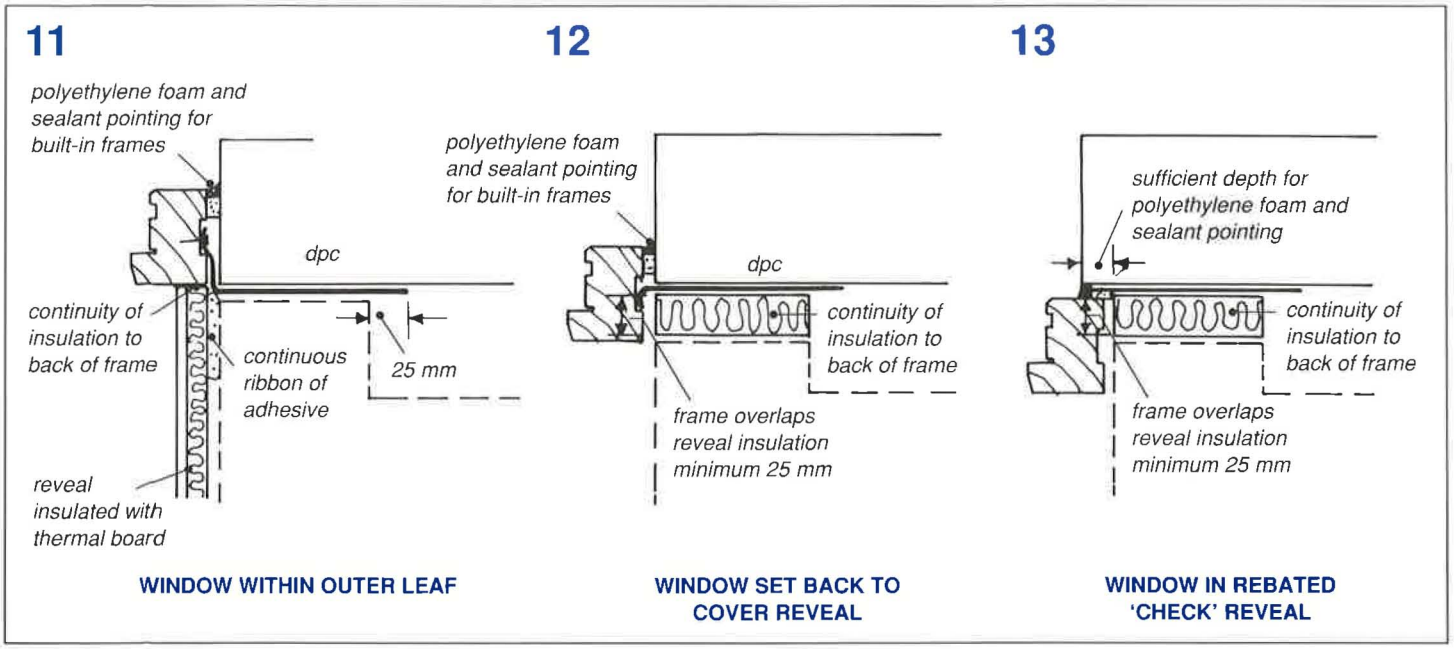
- Unless the soffit has an insulated dry lining, steel lintels with a continuous lower web are best avoided. This is particularly so with rebated windows as the flange supporting the outer leaf is fully exposed externally and its cold mass can cause localised chilling of the plaster soffit.
- The use of polyurethane foam to fill the joint between the frame and the wall can create a useful thermal break, especially with the wider joints that are typical of windows fitted into prepared openings (see Diagram 10).
- If the frame is positioned within the depth of the outer leaf, the window reveal and soffit should be insulated. A 25 mm thick thermal board with 12.5 mm insulation and 12.5 mm plasterboard is sufficient to avoid thermal bridging problems (see Diagram 11).
- Positioning the frame further back in the opening can avoid thermal bridging problems, provided that the frame overlaps the reveal insulation by 25 mm or more (see Diagram 12).
- Positioning the frame in a rebated 'check' reveal and ensuring there is continuity between the wall insulation and the back of the frame should eliminate thermal bridging problems entirely (see Diagram 13).

DETAILING AGAINST AIR INFILTRATION

Air infiltration can be reduced by sealing the gap internally between the frame and the surrounding masonry (see Diagrams 9 and 10). This is especially important where a dry lining is used. Insulating foam applied to the perimeter of the frame is very effective at sealing this gap and is shown in many of the details in this Guide.

Frame with polyethylene backing strip and vertical dpc in place, ready for building in

Injecting foam into the joint around a window fixed in a prepared opening



Detailing to avoid thermal bridging problems with three different window positions

SPECIFICATION

- Specify pre-formed profiles for stop ends and any complicated cavity tray junctions at subsills. The angle of a sloping stop end depends on the cavity width and the lintel profile (see Diagram 8).
- Check that proprietary components are available to suit the cavity width you are using. The range of lintels and some cavity closers for cavities of 75 mm or wider is much less than for a nominal 50 mm wide cavity.

A preformed stop end

- Clay bricks used for subsills should be type FN or FL (ie frost resistant) to BS 3921.
- The durability of extra deep timber sills should be checked, since failures of two piece timber sills have been reported.
- Some proprietary insulated cavity closers provide an adequate fixing for the window frame.
- Sealed double glazed units should have a Kitemark to BS 5713.
- Sealants for external pointing should:
  - have a long life expectancy, ideally 20 years (see table 2)
  - have good adhesion to timber and masonry, ideally without the need for priming
  - be compatible with the window frame material or paint finish; for example, oil based mastics should not be used with microporous finish timber or PVC-U frames
  - preferably be the same colour as the masonry, not the window frame.
- Sealants for internal caulking should have:
  - good adhesion to a range of surfaces without the need for priming
  - a 20-year expectancy
  - a medium to high movement accommodation
  - minimal post application odour
  - a short skin time (4 hours) and cure time (2 to 3 days)
  - a range of suitable colours or be capable of being painted.

Material	Cost	Typical movement accommodation in butt joints	Service life	Comments
Mastic (oil-based)	low-medium	up to 8%	8–10+ years	• reacts with air to form a skin • after skin formation (1-3 days) can be painted to extend its service life • do not use with PVC-U or microporous finishes
Acrylic (water or solvent based)	medium	up to 15%	15 years	• skins over in 1-2 hours • good adhesion • can be applied to damp surfaces • water-based types can be washed out by early contact with rain
Silicone	high	up to 50%	20+ years	• cures with reaction to moisture in the air • excellent ultra-violet resistance

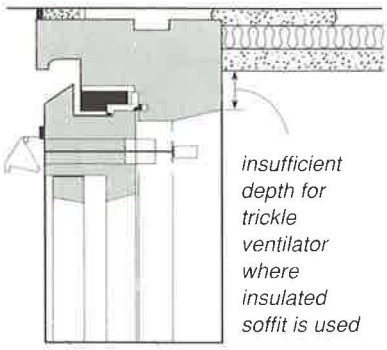
Table 2 Sealants for perimeter pointing of frames

BUILDABILITY

- Stop ends are normally fitted by bricklayers. A preformed stop end which has a self-adhesive strip and release tape enables the bricklayer to bond the stop end to the cavity tray without the need to have cans of adhesive, brushes, or other tools close at hand.
- When detailing windows in a check reveal, dimension the rebate to be of sufficient depth to accommodate the sealant and its backing strip.
- Where a 25 mm thermal board is used at the soffit, it is not usually possible to position a trickle ventilator in the head of the window frame. It will be necessary to choose a design of window frame that can accommodate a trickle ventilator in the head of the opening light (see Diagram 14).

Check that proprietary components are available to suit the required cavity width

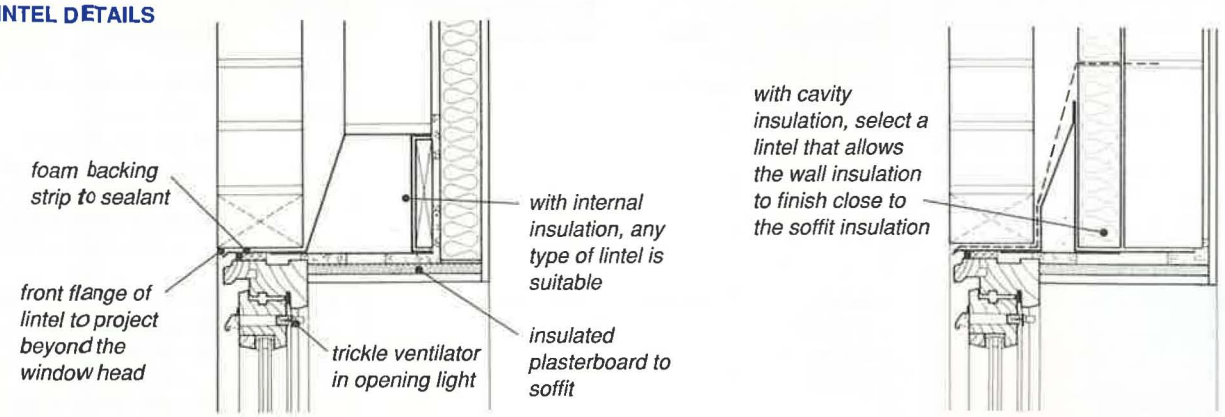
14



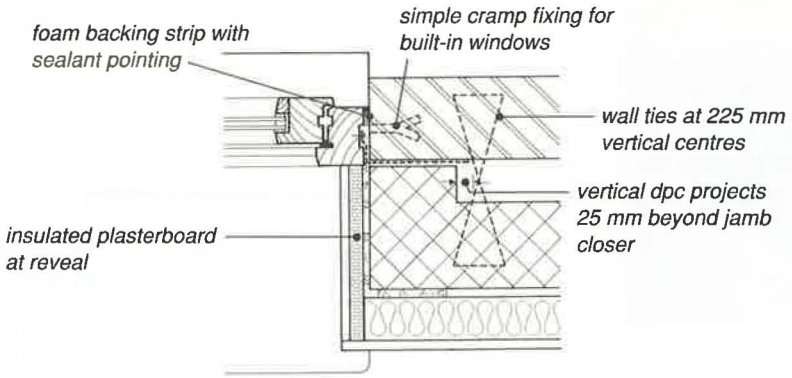
Positioning the trickle ventilator

WINDOW SET FORWARD WITHIN THE OUTER LEAF

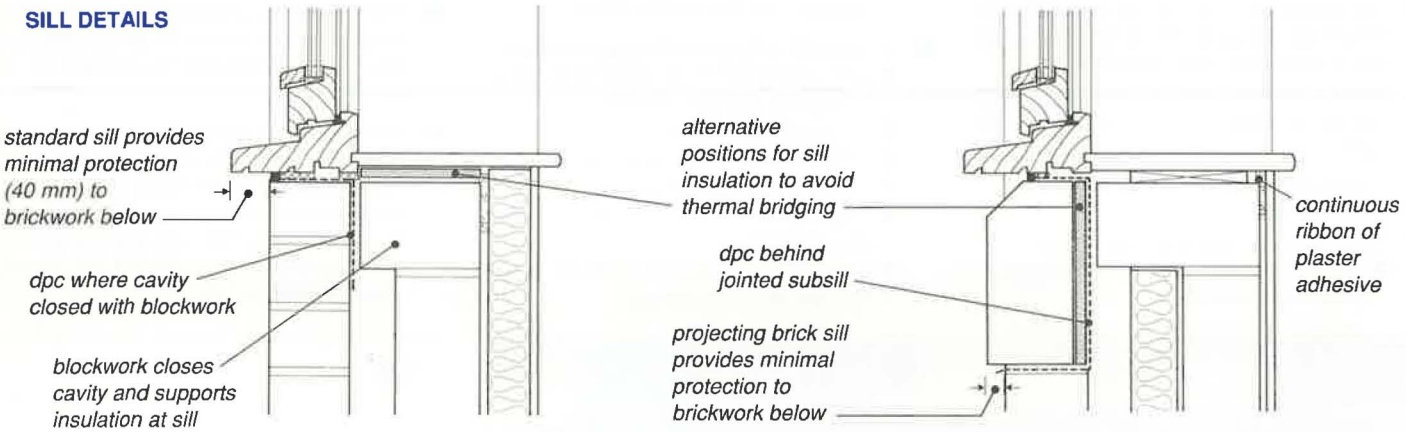
LINTEL DETAILS



JAMB DETAILS



SILL DETAILS



General comments

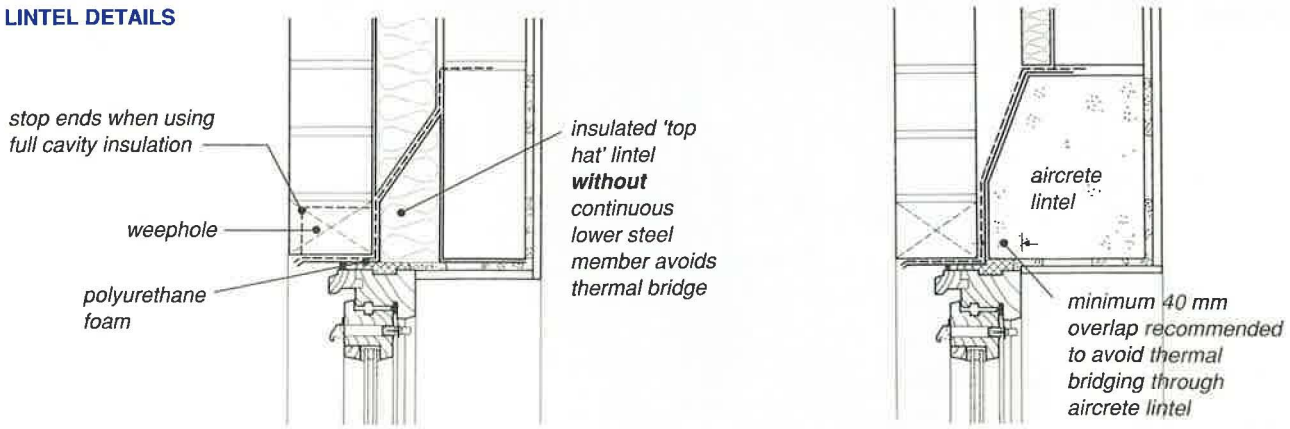
1. Commonly used when windows are built-in during construction.
2. When a timber window is set forward within the outer leaf, the standard sill projects only 40 mm beyond the wall. This detail is therefore only suitable in Sheltered or Very Sheltered exposure zones.
3. If a 50 mm sill projection can be achieved, the exposure rating can be enhanced to Sheltered/Moderate.
4. The details are suitable for a variety of wall insulation positions.

Key detailing points

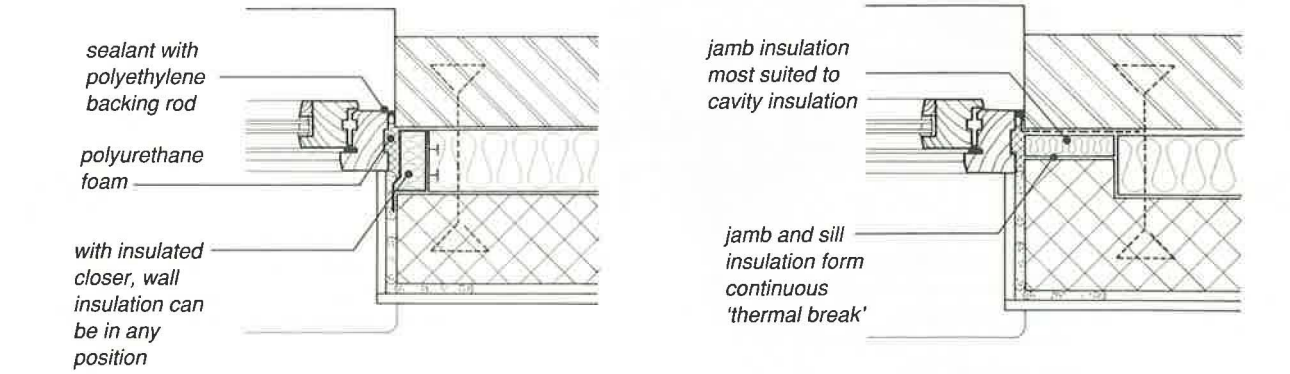
- To avoid a thermal bridge, both the reveal and soffit need to be lined with at least 12 mm of insulation. This applies regardless of the type of wall insulation and lintel. Insulation below the window board is also advisable.
- The front flange of steel lintels should project beyond the head of the window or door frame.
- With insulated soffits, trickle vents should be located in the frame of opening lights.
- The vertical dpc should be fixed to the back of timber frames to protect them from the damp outer leaf.
- When windows are built-in during construction, protect timber sills from mortar droppings. The stains from these can show when translucent finishes are applied to the timber.
- Cramp fixings are used when frames are built-in. When fitted into prepared openings, the frame can be readily wedged in position and screw fixed through shims into the outer leaf.

WINDOW SET BACK FROM THE OUTER LEAF

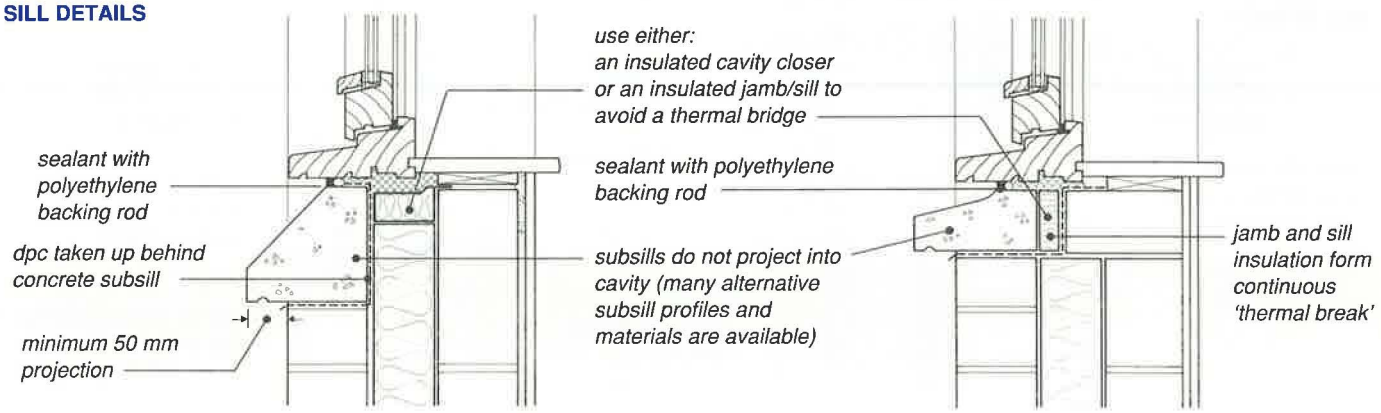
LINTEL DETAILS



JAMB DETAILS



SILL DETAILS



General comments

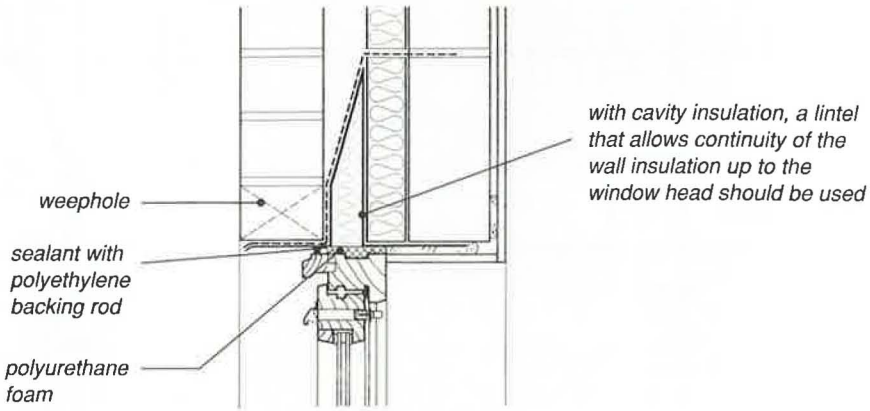
1. When the window is set back, it is likely to be fitted into a prepared opening.
2. Provides better protection than when the frame is set forward and is suitable for exposure conditions up to Moderate/Severe, in combination with appropriate wall constructions.
3. A subsill is required unless an extra deep timber sill is specified. The durability of some two piece timber subsills may not be adequate.
4. The details are suitable for a variety of wall insulation positions.

Key detailing points

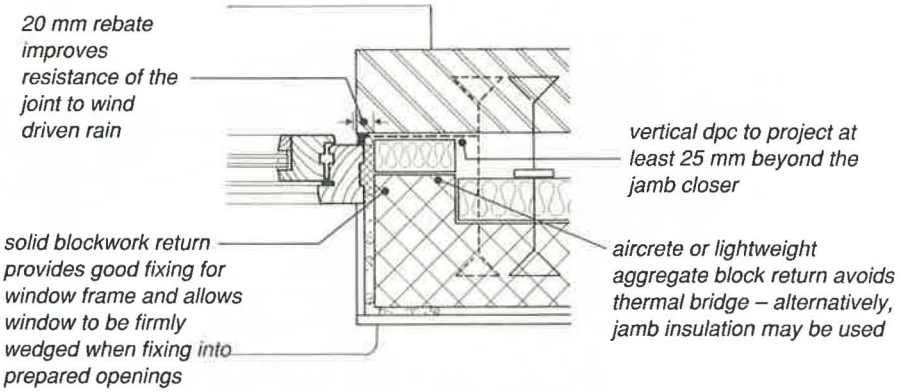
- With the window set back at least 25 mm, the use of an insulating cavity closer or jamb insulation avoids thermal bridging problems.
- With the window set back at least 40 mm, a jamb return of aircrete blockwork avoids thermal bridging problems.
- The use of a 'top hat' lintel with integral insulation, or an aircrete lintel avoids thermal bridging at the soffit.
- Where lintels with a continuous lower web are used, soffit insulation is necessary to avoid local chilling of the plaster at the soffit/window head junction.
- If windows are to be built-in, it may be necessary to use angled cramps to obtain a secure fixing into the inner leaf.
- For windows fitted into prepared openings, lug or bracket fixings are likely to be necessary.
- Detailing the subsill so that it does not project into the cavity simplifies the junction of the vertical and sill dpcs.

WINDOW IN REBATED (or CHECK) REVEAL

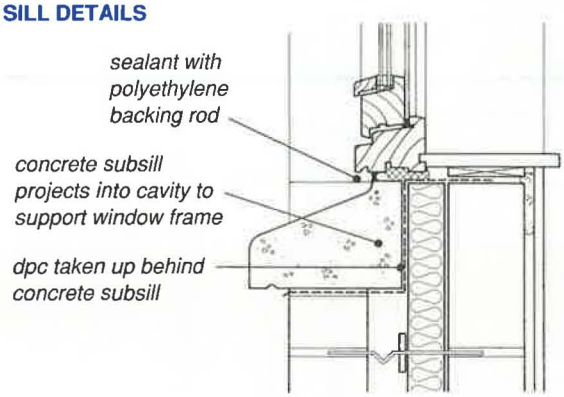
LINTEL DETAILS

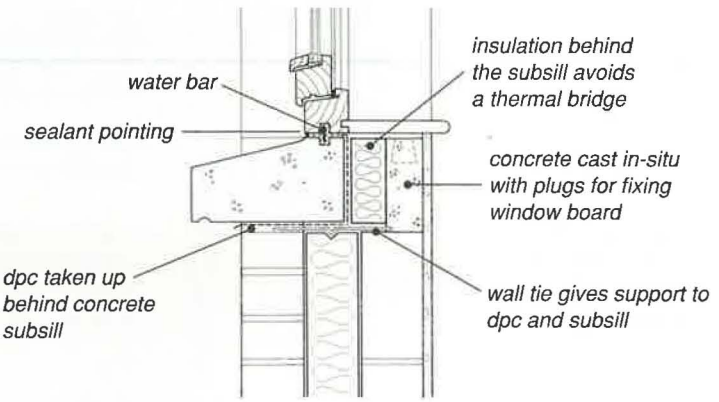


JAMB DETAILS



SILL DETAILS





General comments

1 This is the recommended position for a window in areas with a Severe or Very Severe exposure to driving rain, eg in Scotland and Northern Ireland. The check reveal gives good weather protection to the window.

2 A subsill is essential. This traditionally incorporates a water bar and projects back into the cavity to provide support for the sill.

3 The details are suitable for a variety of wall insulation positions.

Key detailing points

- There is no thermal bridge at the jambs provided there is a strip of insulation between the block return and the outer leaf.
- To prevent a thermal bridge at the concrete subsill, there should be a vertical layer of insulation (minimum 25 mm thick) between the subsill and the inner leaf. This insulation should be positioned directly under the window frame or close to it.
- With blockwork reveals, windows can be readily built-in during construction, using cramps, or alternatively, they can be fixed into a prepared opening by screw fixing directly through the frame.
- Concrete or stone subsills should be built into the wall at each end of the opening and be stooled to course with adjoining masonry.
- Where the subsill projects back into the cavity, care is needed in detailing the junction of the vertical and sill dpcs to ensure:
  - complete separation between internal and external masonry, and
  - that water in the cavity is directed to the outside.
- If the sill detail includes a water bar, check that the window section contains a groove in the correct position to suit the detail.

Guide 96.2

ENERGY EFFICIENCY IN NEW HOUSING

Detailing for designers and building professionals

INTRODUCTION

This Section sets out the specific details that need to be considered when windows are being built-in during construction, including fixing double glazing on site.

The traditional practice of building frames in during construction and glazing on site is often seen as the easiest way of locating and fixing windows and doors into external walls. It is commonly used in the more sheltered areas as a way of avoiding the need for a separate subsill. However, with the frame set well forward, the window/wall junction receives little protection from the weather. This is particularly true where the only seal between the window and the wall is the dpc.

For built-in windows to be suitable for use in energy efficient housing, traditional detailing practice needs to be amended to incorporate double glazing as well as measures to improve air tightness and weather proofing.

MAIN TECHNICAL RISKS

The following technical risks are specific to windows built-in during construction, and are in addition to the main technical risks listed in Section 96.1 of this Guide.

- **Rain penetration** if the waterproof seal between the frame and the wall is inadequate.
- **Air infiltration** through gaps between the frame and the wall at the head, sill and jamb.
- **Deterioration of double glazed units** if edge seals are exposed to sunlight or water is trapped behind the glazing bead.
- **Deformation of window frames** if the frames are not strong enough to carry double glazing or if they are not glazed correctly.

DETAILING TO AVOID RAIN PENETRATION

It has been common practice for windows to be built into the external leaf of a cavity wall with no particular attention to forming a watertight seal, other than the provision of a dpc nailed at intervals to the back of the frame.

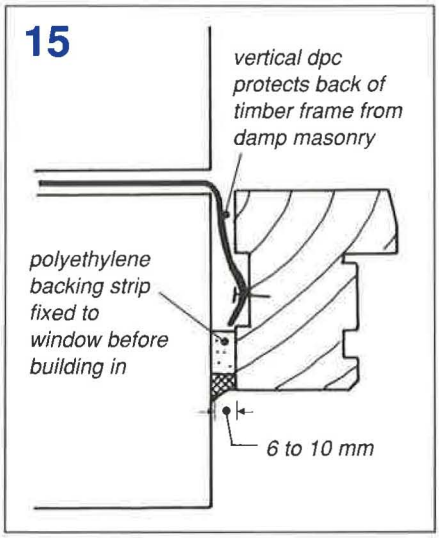
The **key detailing points** follow.

- BS 5628 : Part 3 recommends the use of a sealant between the window frame and the wall, both for rebated and non-rebated structural openings.
- Make provision in the design for the proper application of a sealant by including a strip of flexible foamed plastics as a spacer and backing material between the frame and the wall (see Diagram 15).

FEATURES

- Fixed with cramps as the wall is built.
- Requires no subsill if used in Sheltered and Very Sheltered exposure zones and the frame is set forward.
- In more severe exposure zones, the frame should be set back within the opening and have a subsill.
- Care needed in the selection and specification of frames, beads and glazing compounds for double glazed units.
- Most suited to site fixed double glazing.

Positioning a timber window frame prior to building in



WINDOWS AND EXTERNAL DOORS

Detailing built-in components

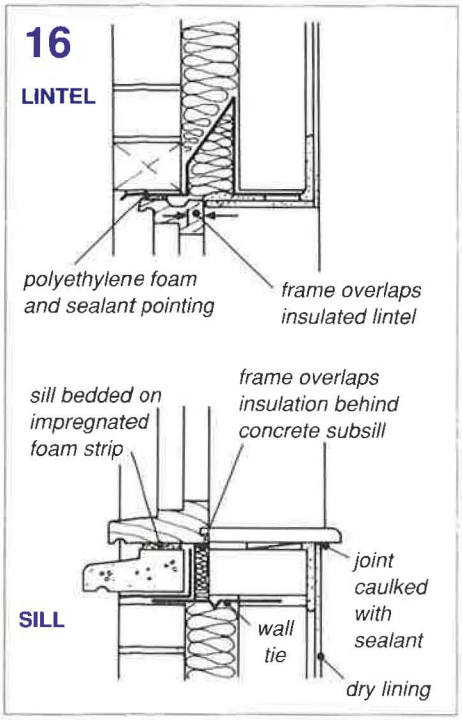
"For built-in windows to be suitable for use in energy efficient housing, traditional detailing practice must be amended to incorporate measures to improve air tightness and weather proofing"

DETAILING AGAINST AIR INFILTRATION

Unless all gaps are sealed, window openings provide an easy route for uncontrolled air infiltration into the dwelling.

The **key detailing points** follow.

- Built-in timber window sills should be bedded on an impregnated foam strip which, when compressed, provides an airtight seal without the need for a sealant (see Diagram 16).
- The polyethylene foam and sealant joint required to resist rain penetration at the jambs also provides an effective air seal.
- The joint between the lintel and the window frame should be filled with a strip of polyethylene foam and pointed with a sealant (see Diagram 16).



Ways of avoiding a thermal bridge and air infiltration at head and sill

DETAILING TO AVOID DETERIORATION OF DOUBLE GLAZED UNITS

Careful choice of windows, double glazing units and glazing method is necessary to avoid deterioration of the edge seals or distortion of the frame.

The **key detailing points** follow.

- The window frame should be designed to accept double glazing and have a glazing rebate at least 18 mm deep. This ensures that there is sufficient cover to protect the edge seal of the double glazed unit from exposure to direct sunlight, and takes into account the tolerances in the frame, and the need for a 3 mm setting block.
- Double glazed units should be fixed using glazing beads. Unless the window frame has a sloping platform (when a drained and ventilated glazing method can be used) the glazing rebate must be solidly bedded to prevent water collecting around the edge seal (see Diagram 17).
- Proprietary beads which not only provide drainage but also offer greater security are available.

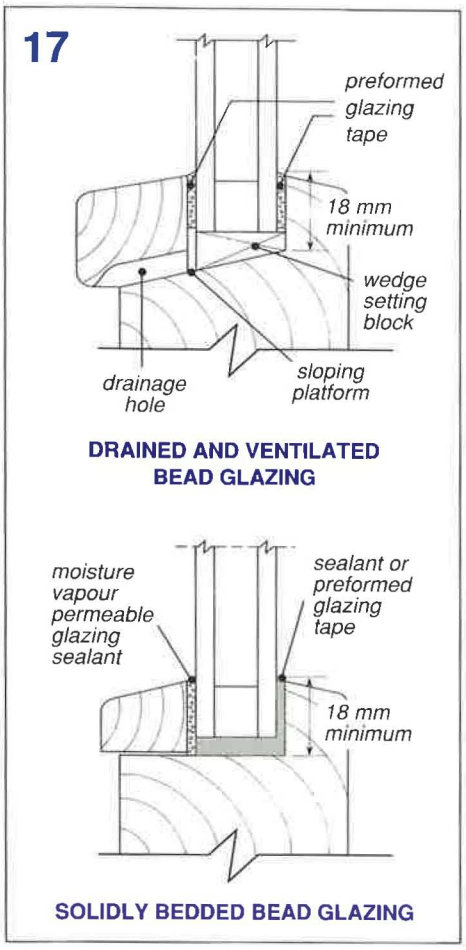
Dpc and polyethylene backing for sealant

SPECIFICATION NOTES

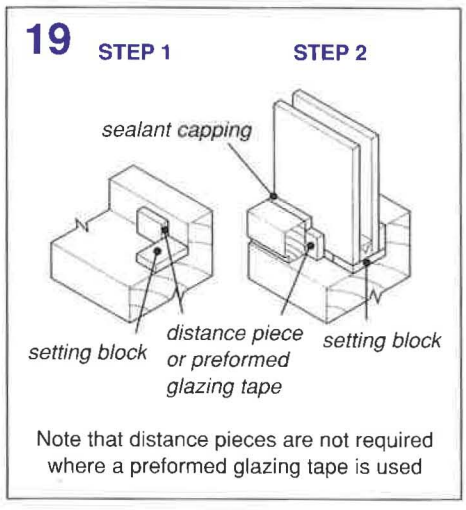
- Fixings for building frames into masonry need to be chosen to suit the position of the frame in the opening. For frames located within the outer leaf, conventional straight frame ties are acceptable. Whereas for frames set back within the opening, angled ties are likely to be needed for fixing into the inner leaf. In this case, consider timber frame cavity ties or threaded wire ties that can be fixed at an angle into the window or door frame (see Diagram 18).
- Check that the glazing compounds are compatible with the edge seal of the double glazing unit and suitable for use with the decorative finish proposed for the window frame.
- Refer to Glass and Glazing Federation Data Sheet 4.2 for details of recommended glazing specifications, including the provision of location blocks and setting blocks to avoid distortion of the frame.
- Check that the window frames, hinges and opening mechanisms are capable of taking the weight of the double glazed units.
- Specify the correct provision of setting blocks and distance pieces (see Diagram 19).

BUILDABILITY POINTS

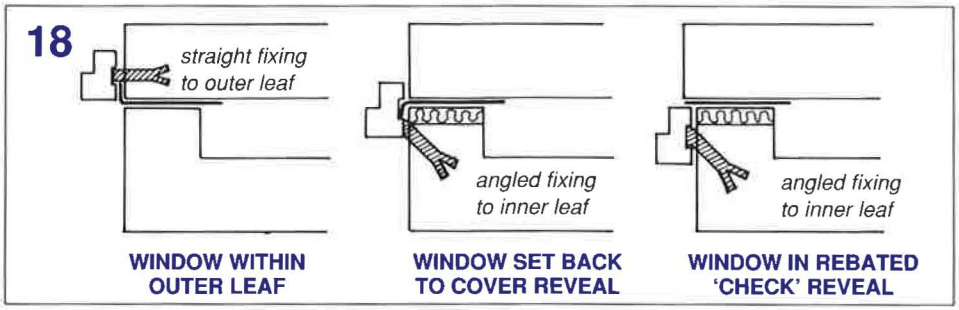
- The polyethylene foam strip ensures that a suitable gap is left for the sealant.
- Where preformed glazing tapes are used to site glaze double glazed units, it is often difficult to exert enough pressure to compress the tape sufficiently to form a weatherproof joint. With drained and ventilated bead glazing this may not be critical, but for solidly bedded glazing methods, a sealant capping to the glazing tape is recommended to provide an effective seal. A gun-applied sealant capping can readily be formed to a smooth chamfer to shed water away from the glass (see Diagram 19).



Alternative bead glazing methods



Provision of setting blocks and distance pieces



Fixing positions for built-in windows

Guide 96.3

ENERGY EFFICIENCY IN NEW HOUSING

Detailing for designers and building professionals

INTRODUCTION

Over recent years there has been a move to using higher performance windows and doors which have their glazing, ironmongery, draughtstripping and decorative finish applied in the factory.

To minimise the risk of damage on site to such highly finished components and avoid consequent delays in completion it is preferable to install them into prepared openings rather than building them in during construction of the external wall. Installing high value products later in the construction sequence also has the added advantage of improving cash flow.

This Section deals with windows that are factory glazed. If double glazing is to be fixed on site, then see Section 96.2 for advice on detailing.

FEATURES

- Openings are formed using either timber frames or proprietary window formers as templates.
- Factory finished windows and doors are less likely to be damaged on site when installed in prepared openings than when built-in during construction of the wall.
- Frames are fixed either by screw fixing through the frame or by means of brackets or lugs.
- Prepared openings require tighter construction tolerances than with built-in windows and doors. Special care is needed to avoid rain penetration and air infiltration.

WINDOWS AND EXTERNAL DOORS

Detailing around factory-finished components

Installing a PVC-U window into a prepared opening

> *"Prepared openings require tighter construction tolerances than with built-in windows and doors. Special care is needed to avoid rain penetration and air infiltration"*

CONSTRUCTION OPTIONS

In the selection of factory-finished windows, the main construction options are the frame material, the type of glazing and the decorative finish. These have little effect on detailing. However, the type of glazing, and to a lesser extent the frame material, have a big influence on the rate of heat loss through the window (see table 3).

With external doors, the detailing options at the structural opening are largely independent of the type of door. However, the heat loss through the door varies considerably according to its construction. In recent years a number of pre-hung, insulated doors have been developed. These come in a range of materials and designs (see table 4). They have the following advantages compared with conventional timber framed entrance doors:

- an insulating core that reduces heat loss (down to about 0.37-0.6 W/m²K)
- composite construction which minimises warping
- draughtseals incorporated as standard, including at the threshold

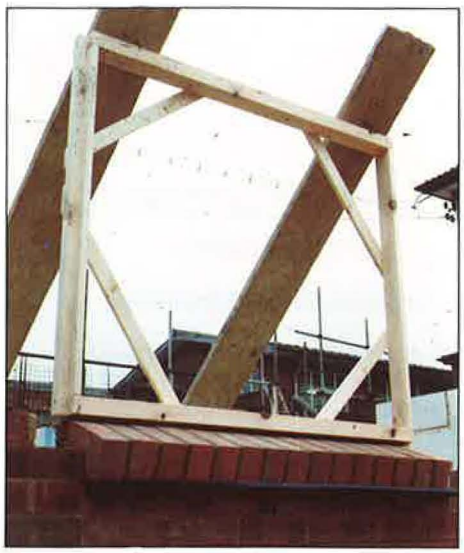
TECHNICAL RISKS

- **Rain penetration** if the joint between the frame and wall is inadequately sealed, or the vertical dpc does not connect with the joint seal.
- **Air infiltration** through joint between the frame and its prepared opening, or between the door or opening light and the frame due to warping or inadequate draughtseals.
- **Thermal bridging** at reveals where the frame is set well forward in the outer leaf.

DETAILING TO AVOID RAIN PENETRATION

When a window is to be installed in a prepared opening, a number of factors, in addition to those for a built-in window, affect the risk of rain penetration. These include:

- the method of forming the prepared opening
- continuity between the vertical dpc and the frame.



A temporary timber template in use

	Single glazing U-values [W/m²K]	Double glazing U-values [W/m²K]		
		14 mm wide (6 mm air space)	20 mm wide (12 mm air space)	20 mm wide (with Low E glass)
Glass only	5.4	3.2	2.8	1.8
Timber frame	4.6	3.0	2.7	1.9
Plastic frame	4.7	3.1	2.8	2.0
Aluminium (thermal break)	5.7	4.2	3.8	2.5
Aluminium (no thermal break)	6.7	5.2	4.7	3.0

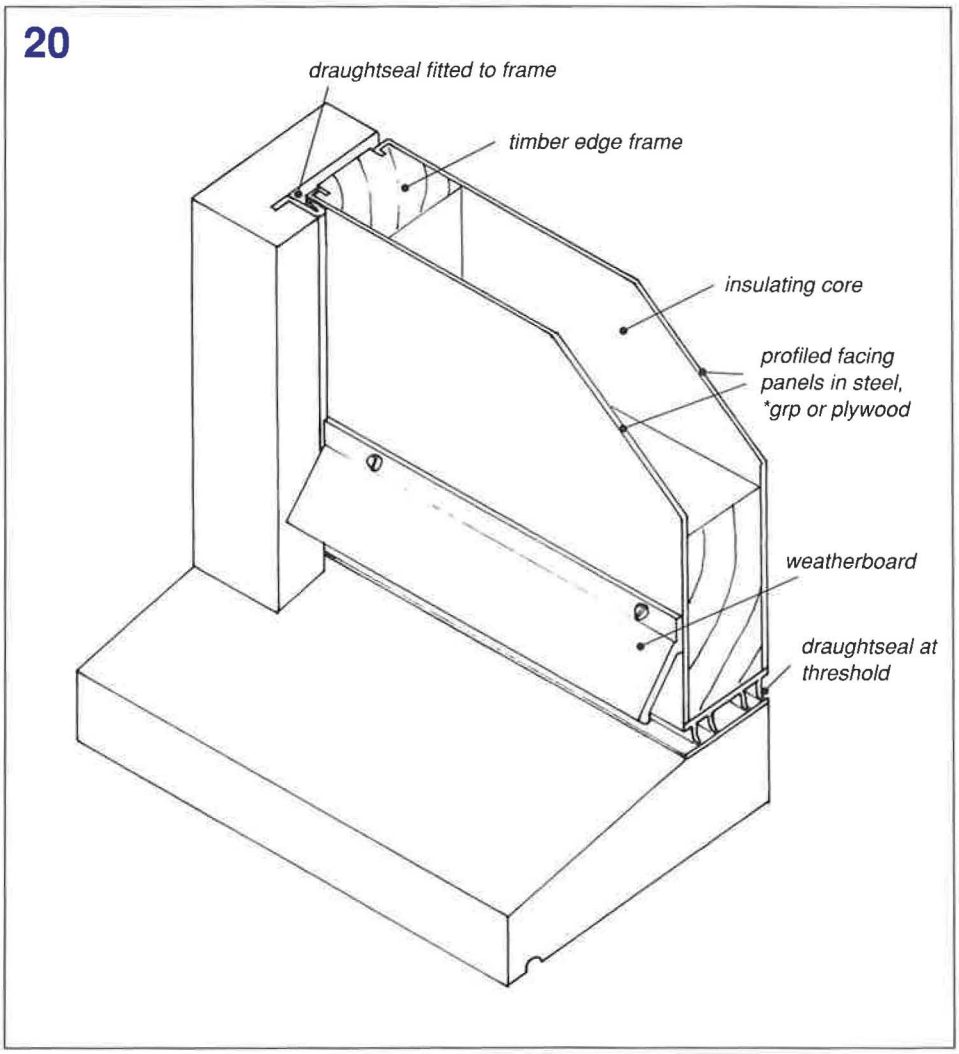
Typical U-values based on Table A3.14 of the CIBSE Guide, assuming that 30% of the window area is occupied by the frame.

Table 3 Comparative U-values for windows

Items	Range of construction options
Finish	steel / grp* / plywood / PVC-U
Core insulation	urethane foam / honeycomb / wood fibre
Level of security	standard 5-lever lock / 3 point locking

Table 4 Construction options with insulated doors

* glass reinforced plastics



Typical construction of insulated door

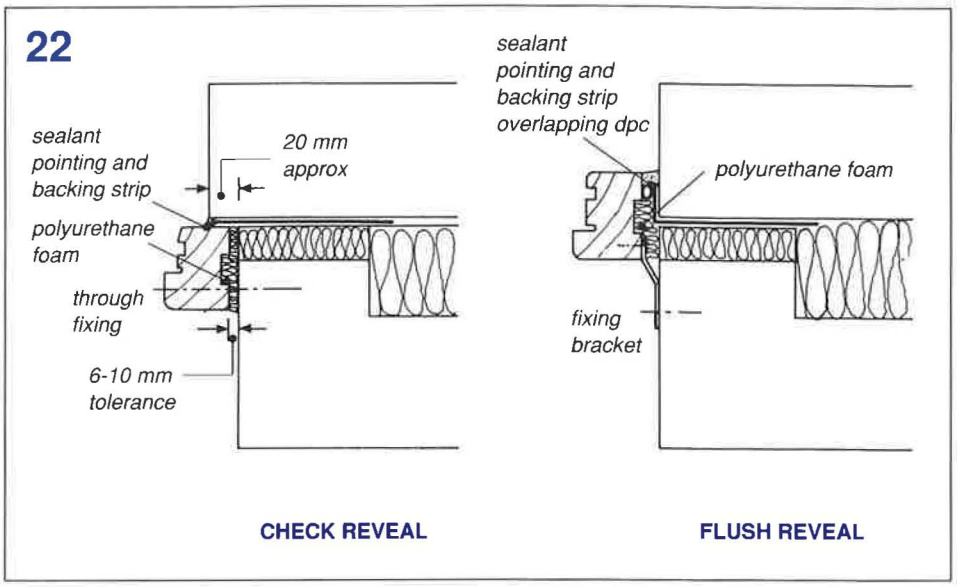
Where the window is placed in a 'check' reveal it is relatively straightforward to seal the dpc to the frame. However, where the window is placed further forward, the vertical dpc becomes hidden behind the frame when the window is installed.

A prepared opening may be formed using:

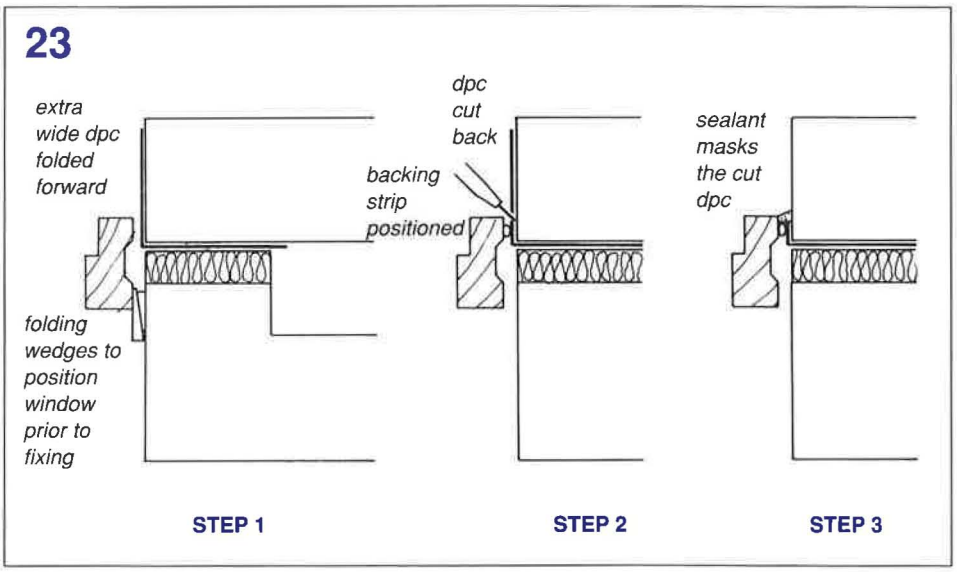
- a permanent sub-frame (usually used with metal windows)
- a temporary timber template
- proprietary systems, some of which incorporate permanent PVC-U extrusions that close the cavity and form the vertical dpc.

The **key detailing points** follow.

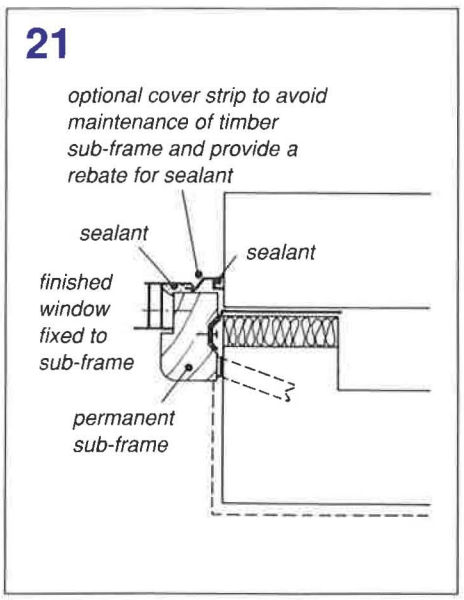
- With a permanent sub-frame, the detailing of the vertical dpc is the same as for a built-in window frame. The finished window should be bedded on a sealant to prevent rain penetration between the window and the sub-frame (see Diagram 21).
- Where a temporary timber template is used to form the opening, window manufacturers recommend that the structural opening should be 12 to 20 mm larger than the finished frame size. This produces a gap of 6 to 10 mm between the frame and the wall which needs to be detailed carefully to prevent moisture reaching the inside. The link between the sealant and the dpc is particularly important (see Diagram 22).
- For a 'flush' reveal, an extra wide vertical dpc should be specified. This can be cut back after the sealant backing strip has been positioned, but before the sealant itself is applied (see Diagram 23).
- The use of proprietary preformed PVC-U extrusions can also be used to form permanent frames that close the cavity and act as rigid dpcs. These can help overcome problems of linking the dpc to the weather sealant. Being made of a rigid material, they do not become dislodged when sealants and backing strips are placed in position (see Diagram 24).



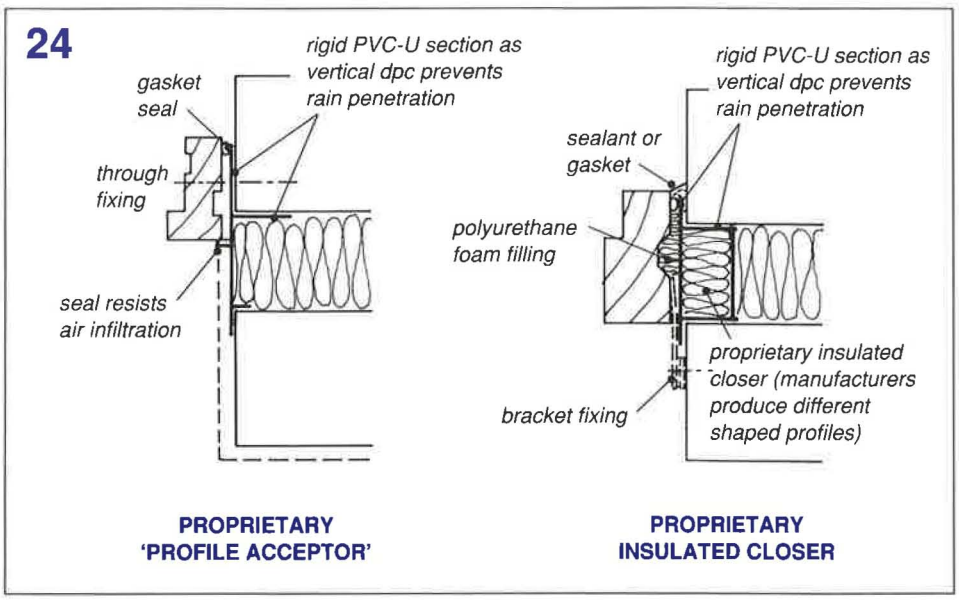
Details of prepared openings for finished windows formed with a temporary timber template



A method of sealing flush reveal for finished windows



Permanent sub-frame for finished windows



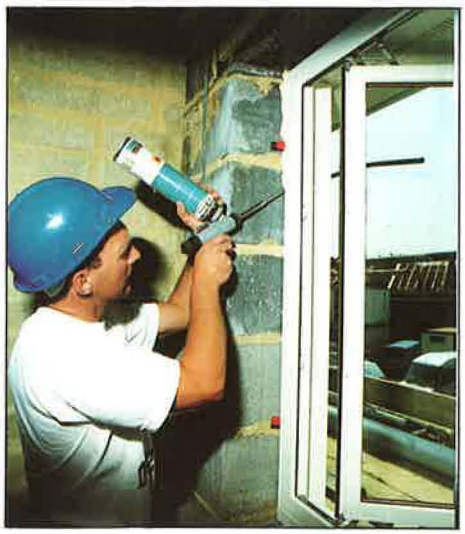
Details of openings for finished windows using proprietary cavity closers

DETAILING TO AVOID AIR INFILTRATION

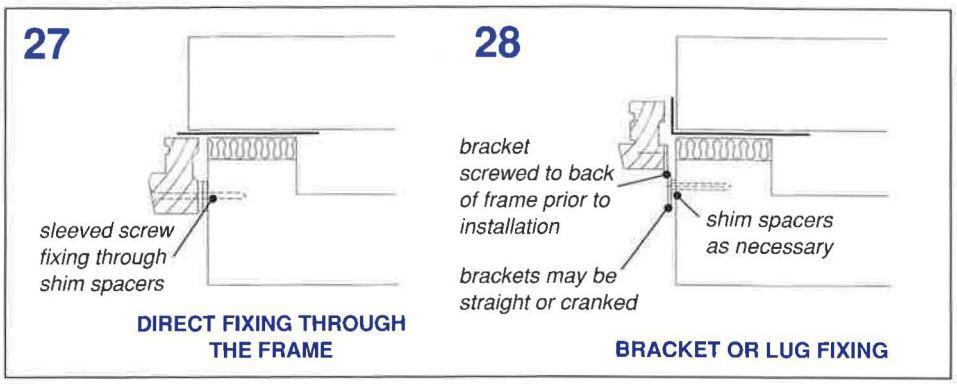
Unless the gaps between the frame and the wall are adequately sealed, they provide an easy route for uncontrolled air infiltration into the dwelling.

The **key detailing points** follow.

- The weather sealant, gaskets or foams needed to resist rain penetration at the frame perimeter also provide an effective air seal.
- The combination of an external sealant and expanding foam filling to the remainder of the joint is particularly effective in preventing air leakage.
- All windows and doors should be fitted with draughtseals, preferably fitted in the factory. While this is standard for most window ranges, not all door frames are supplied with draughtseals, particularly at the threshold.
- Warping of timber, particularly in doors can negate the value of draughtseals. Specifying one of the recently introduced insulated doors with a composite construction should avoid this problem (see Diagram 20).



Injecting polyurethane foam



Fixing options

DETAILING TO AVOID THERMAL BRIDGING

The following points are specific to windows fixed into prepared openings and are in addition to those given on page 6.

The **key detailing points** follow.

- Filling the joint between the frame and the prepared opening with polyurethane foam reduces the risk of thermal bridging (see Diagrams 25 and 26).
- The position of the frame within the opening can influence the method of fixing the window. Frames can either be fixed directly through the frame using sleeved screw fixings (provided there is suitable material for fixing into) or by means of brackets or lugs fixed to the back of the frame (see Diagrams 27 and 28).

DOUBLE GLAZING

The manufacturers of many high performance windows and doors supply their products factory glazed.

The **key detailing points** follow.

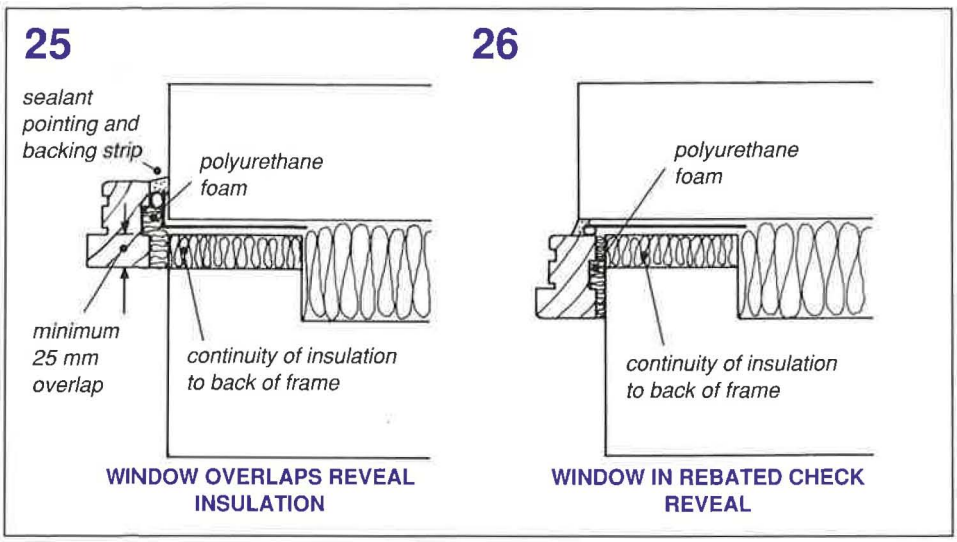
- Factory glazing normally uses dry materials and a drained and ventilated glazing method is often preferred.
- Bench glazing in the factory has the advantage that it is easier to compress the dry glazing strips with the correct degree of pressure to form a weathertight seal, without inducing local stresses in the glazing.

SPECIFICATION NOTES

- Screws and other fixings for securing the frame to its surroundings should either be non-ferrous or, if ferrous, they should have a protective finish, eg zinc coated.
- Specify over-wide dpcs where the detail requires that they be cut back.
- Window manufacturers can supply their windows either primed, with the first decorative coat or fully finished. If frames are supplied fully finished, indicate the level of protection against wet plaster and other trades, especially for stained finishes. Plaster can stain timber, particularly hardwood.
- Specify the method and number of fixings. For frames up to 1200 mm high, one fixing near each corner is normally sufficient, frames over 1200 mm high should have three fixings per side. Doors should have four fixings per side.

BUILDABILITY POINTS

- Folding wedges are normally used in the joint between the frame and the prepared opening to hold the frame temporarily in position prior to fixing. Ensure that the way the joint is detailed does not prevent the use of folding wedges.
- For very heavy components such as doors and large double glazed windows it may be preferable to specify lift off or quick release hinges that allow the frame to be positioned and fixed separately.



Avoiding a thermal bridge at the jamb of finished windows

A prepared opening with rebated reveal